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*Facing Phosphorus Scarcity*

# Phosphorus in Soils and Plants



O511

### How to optimize the use of phosphate resources by producing alternative totally acidulated phosphate fertilizers

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Global phosphorus (P) cycle (GPC) points out substantial losses of P from mining to consumption by humans and it is necessary to increase efficiency as to lower such losses. Totally acidulated phosphate fertilizers (TAPF) are generally required to have high water solubility and such type of fertilizers are obtained either by using high premium grade phosphate rock (PR) or by purifying lower grade rocks at high cost and energy demand. High grade PRs are becoming scarce and the industry will have to rely more frequently in lower grade quality rocks. Researchers studied if it is always necessary that TAPF have high water solubility. Through adequate characterization of the fertilizers' water insoluble P fraction and also the agronomic evaluation of several fertilizers, it was found that many water insoluble compounds may still be good sources of P to plants. Some results show that fertilizers with as low as 43% water solubility in the available P fraction can be as good as fertilizers containing basically only water soluble P compounds. It was also found that some of the water insoluble P compounds may be very good sources of P in specific soil conditions, like flooded soils for rice. The possibility of producing alternative TAPF with lower water solubility can lead to a more adequate use of a finite resource like PR in many parts of the world, which can help to increase the P efficiency in the GPC. Also, results show that P fertilizers with lower water solubility may help to minimize environmental impacts of P in water resources. There is no scientific reason for wasting part of a so valuable resource like PR targeting only the production of TAPF with high water solubility.

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### Population of native PSM increased by Minjingu PR application and positive impact on crop yields in a Kenyan Ferralsol

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Soil microbes such as plant growth promoting rhizobacteria play significant roles in the solubilization of inorganic P, mineralization of organic P and in improving plant P uptake. It is known that phosphate solubilizing microorganisms (PSM) populations largely vary depending on the ecosystems, the cropping systems or the soil management. A total of 150 isolates of PSM were isolated from 13 soils coming from different agricultural provinces in Kenya. Strains belonging to *Bacillus megaterium*, *Bacillus* sp. and *Arthrobacter* sp. were the most abundant and well distributed strains. However, although PSM strains were well present in the different soils, only 5% of the strains were effectively solubilizing P in vitro. The capacity of Minjingu Phosphate Rock (PR) to enhance the populations of native PSM under 3 cereal-legume rotation systems was assessed over two (2) consecutive years. Triple Super Phosphate (TSP) was used as a positive control. In comparison to the negative control, application of Minjingu PR increased the fungal diversity and phosphate solubilizing bacteria (PSB) population by 67-90% while high rates of TSP significantly reduced bacterial diversity and populations of PSB by 46-69%. In addition, Minjingu PR resulted in both crop and legume yields increase (+41-104% compared to the control), which were similar to those obtained with TSP application. Cropping systems incorporating sparingly soluble P sources such as Minjingu PR into soils can stimulate the populations of native PSB and agronomic productivity. The combination of Minjingu PR - PSB may represent a promising way of minimizing the utilization of mineral P fertilizers.